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ATTITUDE, KNOWLEDGE AND CONSTRAINTS ASSOCIATED WITH THE CLIMATE SMART AGRO-PROCESSING TECHNIQUES IN SIERRA LEONE

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Abstract: This paper examines the attitude, knowledge, and constraints associated with climate-smart agro-processing techniques in Sierra Leone using binary logistic regression analysis. From a list of 150 agro-processors, a simple random sampling technique was used to select 134 processors. Data were collected through a structured questionnaire, which was face validated and demonstrated a reliability coefficient of 0.80.

Data were analyzed using the Statistical Package for the Social Sciences (SPSS), Version 26, employing frequency counts, percentages, and binary logistic regression.

Findings revealed that most agro-processors are male, young, with no formal education, and have from 5 to 10 years of operational experience. They exhibit low awareness and knowledge, but a favorable attitude toward climate-smart agro-processing techniques. Radio, workshops, and seminars were identified as the most common sources of information.

The most popular processed products include rice and rice-based products (41.8%) and cassava-derived products (33.6%).

Significant predictor variables for attitude toward climate-smart agro-processing techniques include: gender, age, education, business position, number of employees, years of operation, types of economic activities, market orientation, access to financial support, information sources, energy type, types of products, total by-products, and total number of agro-processing activities. Significant predictor variables for knowledge of climate-smart agro-processing techniques include: total by-product management, APCST constraints, APCST awareness, and APCST use. These significant predictors highlight key intervention areas necessary for effective application of agro-processing techniques aimed at promoting climate adaptation and mitigation.

Keywords: *Climate-smart agro-processing, awareness, constraints, attitude.*

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INTRODUCTION

Agro-processing companies contribute to GHG emissions from their direct energy use (fossil fuels, electricity) and the broader supply chain, including raw material production, Scope 1 (direct), Scope 2 (indirect from purchased electricity), and Scope 3 (indirect from the entire value chain) according to Greenhouse Gas Protocol [1]. Agro-processing contributes to greenhouse gas (GHG) emissions through energy consumption in factories, waste generation, and emissions from pre- and post-production activities in the supply chain.

GHG emissions from processing companies are primarily from energy use (burning fossil fuels) and industrial processes (chemical reactions that transform materials), releasing gases like CO_2 , CH_4 , and N_2O . Greenhouse gases (GHGs) affect climate change by trapping heat in the atmosphere, a process known as the greenhouse effect. The world-total indirect emissions from energy use in cold chains were more than twice the direct component from refrigerants as cold chains are essential components of agrifood system activities, with household consumption and food processing represented the most significant contributors to agrifood system emissions from cold chains [2].

Due to its location, fragile ecosystems, and reliance on climate-sensitive industries like agriculture, Sierra Leone is especially vulnerable to the consequences of climate change. Rising temperatures, prolonged dry spells, sudden flooding, and erratic rainfall have all become more common in the nation [3].

Beyond agricultural output, the broader food system is impacted by climate change, particularly the agro-processing industry, which is crucial to value addition, food preservation, job development, and income generation. Agro-processing refers to the physical, chemical, or biological transformation of raw agricultural inputs into semi-processed or finished products. Common agro-processed products in Sierra Leone include fruit juices, dried fish, palm oil, cocoa powder, milled rice, and gari and fufu derived from cassava, which are essential products for ensuring food supply and nutritional security as well as reducing post-harvest losses [4].

Climate-smart processing techniques focus on increasing agricultural productivity, building resilience to climate change, and reducing greenhouse gas emissions. The key mitigation practices to emission from agro-processing are improving energy efficiency, transitioning to renewables, electrifying processes, sustainable supply chain practices and adherence to ghg protocol standards [5]. Climate-smart agro-processing technologies refer to a suite of innovations designed to minimize carbon emissions, enhance energy and water efficiency, reduce waste, and improve product quality. Climate-smart agro-processing technologies developed and available for adoption among agro-processors are Solar Tunnel Dryers commonly applicable to dehydrating produce such as cassava chips, vegetables, or fruits, eliminating the need for firewood and reducing drying time and offer hygienic drying, better product quality, and reduced labor costs [6]. Energy-Efficient Milling Machines, improves milling technologies, such as rice mills with rubber rollers and adjustable sieves, reduced energy consumption and increase output quality compared to traditional pounding or low-capacity diesel mills [7]. Solar-Powered Cold Storage Units, improves storage techniques especially of perishable agricultural goods using photovoltaic energy, thereby extending shelf life without reliance on grid electricity or diesel-powered refrigeration [8].

Biogas Digesters helps convert organic waste from processing (cassava peels, rice husks, palm oil sludge) into biogas for heating or electricity generation, to reduce environmental pollution, reduce fuel costs, and promote circular economies [9]. Improved Cookstoves and Smokeless Ovens reduce fuelwood consumption and harmful emissions during food processing (fish smoking or palm oil boiling), protect users from indoor air pollution [10]. Eco-Packaging Machines promotes the use of equipment for biodegradable or recyclable packaging, reducing plastic use in food packaging. Eco-packaging is crucial for reducing post-consumption waste and aligning with international food safety standards [11]. The programs to increase capacity, financial incentives, public-private partnerships, and legislative frameworks that promote the use of clean energy, efficient technologies, and sustainable business practices are interventions to promote climate smart agro-processing activities. Furthermore, attaining long-term food system resilience would require incorporating climate-smart processing solutions into development frameworks, green growth initiatives, and national climate action plans. The United Nations Sustainable Development Goals (SDGs), which represent the global conversation on sustainable development, emphasize the necessity of ensuring sustainable patterns of production and consumption (Goal 12), promoting inclusive and sustainable industrialization (Goal 9), and acting quickly to mitigate the effects of climate change (Goal 13).

As the intersection of industry, agriculture, and the environment, the agro-processing sector is essential to this change. Sierra Leone can improve its food security, lower poverty, generate green jobs, and strengthen its climate resilience by coordinating local agro-processing methods with international sustainability goals.

According to [12] the use of solar dryers in cassava processing shortens drying times, enhances product quality, and eliminates firewood use, which lowers emissions and labor costs, while the use of solar mini-grid-powered peanut shellers and energy-efficient rice mills, increases output while lowering expenses. Agro-processors are ill-prepared to meet market needs and climate-related risks because the downstream segments, storage, processing, packaging, and distribution, get relatively less attention [13]. The agro-processing industry's competitiveness and sustainability are weakened by the continued use of antiquated, ineffective, and environmentally damaging methods [11]. The absence of clear policy guidelines, regulatory incentives, or national targets for climate-smart processing has left a void in which processors operate without strategic direction or environmental accountability. Even within climate-related initiatives such as the National Adaptation Plan or the Climate Change Strategy and Action Plan, agro-processing is scarcely mentioned [14]. The continued use of biomass fuels and manual methods not only compromises productivity but also exposes them to climate and health risks [15]. In 2018, the Sierra Leone Agro Processing Competitiveness Project focussed on strengthening agro-processing competitiveness, in terms of the ability of agro-processing firms to generate new investments and increase market share in goods and services through improved productivity objectives, improved business environment with a obvious neglect of climate smart processing techniques [16].

This study explores the Knowledge, Attitude, and Practices (KAP) model in agriculture, which is a framework used to study how a farmer's knowledge, beliefs, and actions relate to agricultural practices like sustainable methods, new technologies, or specific inputs. It assesses how a farmer's understanding of a concept (knowledge), their feelings about it (attitude), and their actual behavior (practice) influence outcomes such as adoption of new techniques, environmental impact, and productivity.

This model helps identify gaps between what farmers know, how they feel, and what they do, providing insights for designing more effective agricultural extension and education programs [17-19]. This study demonstrates that attitudes, resource access, and structural impediments facilitate the shift from awareness to practice, this work enhances agricultural innovation systems theory. The requirement for heterogeneity-aware extension tactics is implied by the advancement of farmer segmentation theory, since adoption behaviors differ according to economic capability, education, and market integration. By highlighting the necessity of enabling contexts, the persistent KAP gaps also support Behavioral Change Wheel models.

Any agricultural technology's spread and uptake are impacted by farmers' attitudes towards it, their familiarity with how it works, and the limitations they face in their sociocultural environment. Adoption decision-making is heavily influenced by information, attitudes, and perceptions [20]. Farmers' perspectives and attitudes are based on their understanding of any agricultural technology, including its application, predicted results, environmental benefits, hazards, and expenses. Based on their perceived needs and past experiences, farmers' perceptions of innovations are strongly related to their awareness and knowledge of such technologies, which may not always match reality. Farmers' attitudes towards agricultural innovation are influenced by their views and knowledge of it. Positive attitudes, a high degree of knowledge, and few barriers have been identified in a number of studies on the adoption of agricultural technologies. According to [21], smart agriculture technology adoption in Taiwan was positively impacted by farmers' knowledge and attitudes. According to [22], favourable attitudes towards technology have a substantial impact on the adoption behaviours of Litchi farmers in China. According to [23], farmers in northeastern Nigeria's adoption of enhanced pearl millet was greatly influenced by their knowledge and attitudes.

The attitude, knowledge, and constraints associated with agro-processing techniques are intertwined, with knowledge and attitude often determining the adoption and success of specific methods. A positive attitude and high knowledge level promote the uptake of technologies, while various structural and financial constraints often hinder their implementation. Attitude as an individual's disposition and evaluative affect toward a particular technology or practice. Processors generally exhibit a positive attitude towards technologies perceived to be useful, profitable, and capable of enhancing performance, such as value-addition techniques. A positive correlation exists between attitude and actual practice. Attitudes can be negatively influenced by a lack of awareness, risk aversion, or prior negative experiences. For instance, a perceived complexity of operation can lead to a poor disposition toward a new technology [24 – 29].

Knowledge encompasses the awareness, understanding, and technical proficiency required to use a particular agro-processing technique effectively, and it has been reported as a significant predictor of the successful adoption and effective utilization of agricultural innovations and processing techniques often influenced by awareness with sources of knowledge as training programs, extension agents, farm groups, and informal information sharing [30, 25, 29]. While [31, 32, 29] noted that constraints are the challenges and barriers that impede the ability of farmers and small-to-medium enterprise (SME) agro-processors to deploy and utilize technologies effectively. Several authors listed constraints to the use of agro-processing techniques to high costs of equipment, lack of access to credit or suitable financing instruments, high interest rates, expensive maintenance, inadequate on and off-farm infrastructure, unreliable power supply, and a

lack of appropriate technologies suited to small-scale operations are common issues. Similarly, lack of awareness of existing technologies, slow access to timely information about the latest methods, insufficient liaison with processors or extension services acts as significant barriers, challenges in the supply chain, raw material unavailability, inadequate storage facilities, difficulty in maintaining consistent product quality, and limited market avenues for processed products, are major constraints. The lack of skilled manpower and technical expertise to operate complex machinery or analyze data can also hinder adoption. According to [29], farmers in North Western Nigeria use mobile phone-based applications poorly. Therefore, this study investigates the attitude, knowledge and constraints to the use of climate smart agro-processing techniques in Sierra Leone.

MATERIAL AND METHODS

This study employed descriptive research design, with all agro-processors as the population of the study. The majority of agro-processors are located in major cities in Sierra Leone as the cities serve as the commercial, administrative, and economic hub of Sierra Leone [4]. A wide range of agro-processing companies in the city transform key crops such as cassava, rice, palm oil, maize, and cocoa into consumable and exportable goods. The city's strategic location, proximity to major transportation networks, availability of skilled labor, and access to financial and technological resources make it an ideal.

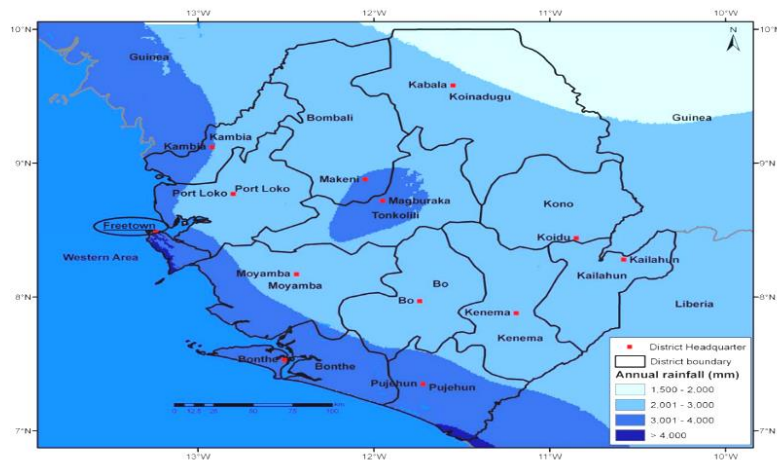


Figure 1. Location of study area and Sierra Leone

From the list of 150 agro-processors in the Western Area Urban Business Registry and the [33] a simple random sampling technique was used to select 135 processors. Data for the study were collected with structured questionnaire developed based on the objectives of this study. The questionnaire is made up of six sections. The questionnaire's sections were designated A through F. Section A of the questionnaire collected socioeconomic and demographic data from the agro-processors, while, Section B gathered information awareness and adoption of climate-smart agro-processing techniques rated by respondents on a 3-point scale of Aware, aware not adopted and adopted covering 50 techniques.

Section C of the questionnaire ascertained attitudes toward agro-processing climate-smart practices with a 5-point Likert scale Strongly Agree (5), Agree (4), undecided (3), disagree (2), Strongly disagree (1) covering 35 attitudinal statements. Section D examined information sources use among agro-processors, while Section E solicited information on the constraints to adopting agro-processing climate-smart practices. A list of 25 constraints was rated by respondents on incidence and impact scales. The questionnaire was face validated by experts in climate-smart agriculture, agro-processing, and food science from School of Agriculture and Food science, while the split-half techniques gave a reliability coefficient with Cronbach's alpha of 0.80; and the Research Ethics Committee of Njala University approved this study.

The data collected from the structured questionnaires were analysed **using** Statistical Package for the Social Sciences (SPSS) Version 26 with frequency counts, percentages and Binary logistic regression. The link between one or more explanatory variables (independent variables) on a category or interval scale and the response variable (dependent variable), which has two or more categories, was predicted using logistic regression. According to [34], when the response variable is binary or dichotomous, the logistic regression analysis characterizes the relationship between the response variable (outcome or dependent) and a collection of predictor variables (explanatory or independent) as described in Table 1. The response variable is dichotomous qualitative data, where a value of 1 (one) denotes the occurrence of an event and a value of 0 (zero) denotes its non-occurrence. The general form of the logistic regression equation model is formulated as follows:

$$\pi_{(j)} = P(Y = 1|X) = \frac{e^{\beta_0 + \beta_{10}x_{j1} + \beta_{20}x_{j2} + \dots + \beta_p x_{jp}}}{1 + e^{\beta_0 + \beta_{10}x_{j1} + \beta_{20}x_{j2} + \dots + \beta_p x_{jp}}} \quad (1)$$

The link function used is logit, with the logit of π ie;

$$\text{logit}(\pi) = \log\left(\frac{\pi_j}{1 - \pi_j}\right) = \beta_0 + \beta_1 x_{j1} + \beta_2 x_{j2} + \dots + \beta_p x_{jj} \quad (2)$$

Table 1. Descriptions of variables in the study.

Variables	Description	Expected sign
Gender	Dummy =1 if Male, 0 female	+/-
Age	Age in years	+
Education	Dummy =1 formal education, 0 otherwise	+/-
Position in the business	Dummy =1 Employee, 0 otherwise	+/-
No employees	Number of persons	+
Years of Operation	Number of years	+
Economic activities	Dummy =1 Production, 0 otherwise	+/-
Production activity	Dummy =1 Production of raw materials, 0 otherwise	+/-

<u>Contin. Table 1.</u>		
Social responsibility	Dummy =1 environmental, 0 otherwise	+/-
Market orientation	Dummy =1 local market, 0 otherwise	+/-
Access to financial support	Dummy =1 self-funded, 0 otherwise	+/-
Info sources	Dummy =1 radio, 0 otherwise	+/-
Energy type	Dummy =1 non-conventional, 0 otherwise	+/-
Energy use total	Pooled energy score	+
Types of products	Dummy =1 rice, 0 otherwise	+/-
Products total	Pooled products score	+
By-product total	Number of by-products generated	+
total by-product management	Pooled by-products score	+
No of activities	Number of agro-processing activities	+
Total no of activities	Pooled agro-processing activities score	+
Awareness of APCST	Pooled awareness scores	+
Knowledge of APCST	Pooled use scores	+
total attitude score on APCST	Pooled attitude scores	+
total constraints score on APCST	Pooled constraints scores	+
Energy use binary score	Dummy =1 if high, 0 otherwise	+/-
AWARE binary score	Dummy =1 if aware, 0 otherwise	+/-
Use of APCST binary score	Dummy =1 if use, 0 otherwise	+/-
Attitude towards APCST binary score	Dummy =1 if favourable attitude, 0 otherwise	+/-

RESULTS AND DISCUSSION

Table 2 present the demographic characteristics of agro-processors, and the findings revealed that agro-processors are mainly males, less than 40 years, with no formal education, having more than 10 employees, within 5 to 10 years of operation, having low awareness, low knowledge, but favourable attitude. These results aligned with other authors that women are the primary labor force in agro-processing (UN Women 2017), male agro-processors predominate in Nigeria, South Africa and Zimbabwe [35-36]. Similarly, majority of agro-processors across Africa are young [37], have intermediate level of education [38], most agro-processing enterprises last for only five years [39], and agro-processing enterprises predominate rural areas [40].

Furthermore, many small and medium agro-processing enterprises (SMEs) low rates of energy access [41], use a mix of traditional and modern energy sources [42]. The agro-processing enterprises revolve mainly around the food systems [43-44], and managed by-products through circular economy [45].

Table 2 Demographic characteristics of agro-processors

Variables	Mean	Std. Deviation	Variance	Min.	Max.	Remarks
Gender	NA	NA	NA	NA	NA	Mainly males
Age	34.04	7.51	56.434	23.00	67.00	Mainly less than 40 years
Education	NA	NA	NA	NA	NA	Mainly no formal education
Position in the business	NA	NA	NA	NA	NA	Mainly employees
No employees	10	46.75	21.28	3.00	30.00	Mainly more than 10
Years of Operation	6.23	3.26	10.67	2.00	20.00	Mainly 5-10 years
Economic activities	NA	NA	NA	NA	NA	Mainly production
Production activity	NA	NA	NA	NA	NA	Mainly gen. of raw material
Social responsibility	NA	NA	NA	NA	NA	Mainly environ. impact
Market orientation	NA	NA	NA	NA	NA	Mainly local market
Access to financial support	NA	NA	NA	NA	NA	Mainly self-funded
Info sources	NA	NA	NA	NA	NA	Mainly radio
Energy type	NA	NA	NA	NA	NA	Mainly conventional
Energy use total	43.85	25.19	4.59	0.00	122.00	Mainly solar
Types of products	NA	NA	NA	NA	NA	Mainly rice
Products total	1.16	0.99	0.98	0.00	6.00	Mainly 3 products
By-product total	1.38	1.28	1.65	0.00	9.00	Mainly 3 by-products
total by-product management	2.58	2.29	5.26	0.00	11.00	Predominantly 3 by-products
No of activities	2.60	3.07	9.42	0.00	11.00	Predominantly 3 activities
Total no of activities	4.11	3.02	9.09	0.00	14.00	Mainly 3 activities
Awareness of APCST	2.79	5.68	32.36	0.00	29.00	Mainly low awareness
Knowledge of APCST	42.38	38.08	15.61	0.00	123.00	Mainly low knowledge
total attitude score on APCST	86.39	43.41	14.66	0.00	125.00	Predominantly positive
total constraints score on APCST	44.38	24.72	611.09	0.00	75.00	Mainly high constraints
Energy use binary score	NA	NA	NA	NA	NA	Mainly low use

Contin. Table 2.						
AWARE binary score	NA	NA	NA	NA	NA	Mainly not aware
Use of APCST binary score	NA	NA	NA	NA	NA	Mainly non use
Attitude towards APCST binary score	NA	NA	NA	NA	NA	Mainly favourable attitude

Table 3 presents the results on the sources of information on climate-smart agro-processing techniques. The results show that radio, workshop & seminar are the most common source of information with 67.2% and 44% of agro-processors respectively. This dominance underscores the pivotal role of radio in information dissemination among agro-processing enterprises in Sierra Leone. Radio remains the most accessible, affordable, and widespread medium for communication, particularly in rural and semi-urban communities where internet connectivity is limited. The results reveal that industry and enterprise linkages is weak as 80.6% of the agro-processors indicated that they do not get information through industry. The same trend is applicable to National standards organization (84.3%) and Newspapers (82.8%). These are followed by NGOs and development partners (69.4%) and Farmer cooperatives or associations (69.4%). The sustainability was significantly influenced by socioeconomic factors including information sources among pineapple processors in Ghana [46], and [47] found a very low awareness and level of exposure to agro-processing equipment among agro-processors in Nigeria.

Table 3. Sources of information on climate-smart agro-processing techniques

Sources of information	Yes	No
Radio	90(67.2)	44(32.8)
Industry	26(19.4)	108(80.6)
National standards organization	21(15.7)	113(84.3)
Newspapers	23(17.2)	111(82.8)
Internet	41(30.6)	93(69.4)
Co-processors	21(15.7)	113(84.3)
Agricultural extension services	54(40.3)	80(59.7)
Mobile applications (e.g., WhatsApp groups, AgriApps)	42(31.3)	92(68.7)
Workshops and seminars	59(44.0)	75(56.0)
NGOs and development partners	41(30.6)	93(69.4)
Farmer cooperatives or associations	41(30.6)	93(69.4)

Source: Field data, 2025.

The results on products by small, medium agro-processing firms in Sierra Leone is shown in Table 4. Rice and rice-based products (41.8%) and cassava and items produced from cassava (33.6%) are the most popular products. These goods centre round the primary commodities and food systems in Sierra Leone. This could be due to the fact that rice milling is still the most well-established agro-processing sector in districts like Bo, Bombali, and Tonkolili, where tiny mills run all year round. The development of locally made milling machines and donor-supported mini-mills has significantly enhanced rice processing. Due to the crop's versatility, year-round availability, and hardness, processing of cassava is common. Its high prevalence can be explained by the fact that it requires very simple technology and offers a quick turnover for modest processors. Additionally, the development of the cassava value chain has been aided by government and non-governmental organisation initiatives that foster food self-sufficiency. On the other hand, fruit-juice and jam processing (7.5%) and groundnut-based goods (5.2%) have the lowest percentages. This could be as a result of the surveyed businesses' comparatively immature groundnut oil extraction and peanut flour production processes. Few businesses engage in formal juice or jam processing despite the abundance of fruit output, including oranges, pineapples, and mangoes. Growth in this market is hampered by high spoiling rates, a lack of cold-chain facilities, inadequate packaging technologies, and difficult access to high-quality bottles or preservatives. Small and medium agro-processing enterprises in West Africa generate a variety of products from local crops, including processed grains like packaged maize and rice flours, processed root crops like cassava flour, and oils from nuts such as palm, shea, groundnut, and cashew [48]. Other products include processed fruits and fruit juices, and non-food items like cotton yarn and fabrics.

The processed food is mainly produced by Small and Medium Enterprises, for African consumers for over 50 years [49].

Table 4. Products generated by small, medium agro-processing enterprises

Products Type	Yes	No
Milk	2(1.5)	132(98.5)
Yoghurt	7(5.2)	127(94.)
Groundnut oil	18(13.4)	116(86.6)
Poultry feeds	30(22.4)	104(77.6)
Rice milling	42 (31.3)	92(68.7)
Cassava flour	24(17.9)	110(82.1)
Palm kernel oil	11(8.2)	123(91.8)
Dried fruits (e.g., mango, pineapple)	11(8.2)	123(91.8)
Cocoa butter	31(23.1)	103(76.9)
Tomato paste	11(8.2)	123(91.8)

Source: Field data, 2025.

Table 5 presents the results on agro-processors' attitude towards climate-smart agro-processing techniques, with agro-processors favourably disposed to most of the statements with high percentages recorded.

The prominent attitudinal statements are APCST require advanced technical knowledge (58.2%), adopted when promoted by fellow processors (53.0%), more effective when combined with digital tools for monitoring (53.0%), essential for improving competitiveness in regional and international markets (53.0%), and require support from government and NGOs for successful adoption (51.0%). This may be due to the fact that agro-processors in Sierra Leone have low knowledge of Agro-processing Climate-smart techniques (APCST), operate on a low-level economy of scale and rely on NGOs and government for investments in the post-civil war era. Attitudes towards agro-processing techniques are diverse, generally viewed positively for their potential in economic development and food security, but often met with caution or neutrality by smallholder farmers due to barriers like lack of knowledge, financial constraints, and limited access to infrastructure and training [50]. A positive farmer attitude towards improved cassava processing technology is strongly linked to its adoption, meaning farmers who believe the technology is useful and feasible are more likely to use it. Key attitudinal factors include perceiving the technology as beneficial and having the confidence (self-efficacy) to use it, while negative attitudes, often linked to a lack of awareness or training, can hinder adoption despite potential benefits [51-53].

Table 5. Attitude to climate smart processing techniques by small, medium agro-processors

Statements on Agro-processing Climate-smart techniques (APCST)	SD	D	U	A	SA
APCST require advanced technical knowledge.	1(0.7)	1(0.7)	29(21.6)	25(18.7)	78(58.2)
APCST are too expensive for small enterprises.	0(0)	3(2.2)	32(23.8)	42(31.3)	57(42.5)
APCST are difficult to use without prior training.	1(0.7)	4(3.0)	33(24.6)	37(27.6)	59(44.0)
APCST do not offer direct financial rewards to adopters.	7(5.2)	9(6.7)	39(35.7)	32(23.9)	47(35.1)
APCST are not supported by strong policy frameworks.	2(1.5)	4(3.0)	37(27.6)	49(36.6)	42(31.3)
APCST increase the cost of production.	5(3.7)	2(1.5)	32(23.8)	51(38.1)	44(32.8)
APCST impact the environment negatively.	7(5.2)	15(11.2)	32(23.8)	28(20.9)	52(38.8)
Contin. Table 5.					
APCST threaten traditional agro-processing jobs.	3(2.2)	14(10.4)	38(28.3)	39(29.1)	40(29.9)
APCST improve the shelf-life of processed products.	4(3.0)	7(5.2)	34(25.3)	43(32.1)	46(34.3)
Contin. Table 5.					
APCST enhance food safety standards.	0(0)	13(9.7)	30(22.3)	53(39.6)	38(28.4)

Contin. Table 5.					
APCST are adopted when promoted by fellow processors.	3(2.2)	4(3.0)	28(20.9)	28(2.9)	71(53.0)
APCST face limited adoption due to lack of awareness.	2(1.5)	1(0.7)	31(29.7)	45(33.6)	55(41.0)
APCST Can improve the public image or branding of agro-enterprises.	4(3.0)	3(2.2)	29(28.2)	45(33.6)	53(39.6)
APCST require financial incentives for wider adoption.	2(1.5)	3(2.2)	32(30.4)	40(29.9)	57(42.5)
APCST reduce post-harvest losses.	3(2.2)	4(3.0)	34(31.9)	52(38.8)	41(30.6)
APCST are critical to mitigating climate change impacts	4(3.0)	0(0)	34(31.9)	34(25.4)	62(46.3)
APCST encourage sustainable use of natural resources.	0(0)	3(2.2)	30(22.4)	47(35.1)	54(40.3)
APCST improve profitability of agro-processing businesses.	0(0)	3(2.2)	31(29.7)	41(30.6)	59(44.0)
APCST require support from government and NGOs for successful adoption.	1(0.7)	3(2.2)	28(27.4)	33(24.6)	69(51.5)
APCST may disrupt existing agro-processing routines.	5(3.7)	12(9.0)	37(34.2)	43(32.1)	37(27.6)
APCST are not necessary for small-scale agro-processors.	3(2.2)	14(10.4)	32(30.4)	43(32.1)	42(31.3)
APCST adoption is limited by lack of access to equipment.	0(0)	1(0.7)	32(30.4)	34(25.4)	67(50.0)
APCST support modernization of agro-processing.	2(1.5)	1(0.7)	29(28.2)	50(37.3)	52(38.8)
APCST are more effective when combined with digital tools for monitoring.	0(0)	2(1.5)	31(29.7)	30(22.4)	71(53.0)
APCST are essential for improving competitiveness in regional and international markets.	0(0)	1(0.7)	32(30.40)	30(22.4)	71(53.0)

Sources: Field Data, 2025.

The results in Table 6 cover knowledge of climate smart agro-processing techniques among small and medium agro-processing enterprises in Sierra Leone, which reveal that majority agro-processors have low knowledge of climate-smart agro-processing techniques.

Agro-processors have low knowledge on use of canning (61.9%), level of homogenization (54.5%), level of pasteurization (52.2%), high hydrostatic pressure processing (49.3%), level of irradiation applied (49.3%), use of fast-cooking crop varieties (47.0%), types of packaging materials used (47.0%), use of biodigesters (46.3%).

Due to institutional limitations, high costs, inadequate information, and restricted access to technology, there is a lack of understanding regarding climate-smart agro-processing processes [54].

Agro-climate smart technologies include solar energy methods for drying agricultural products, greenhouse technology for cultivation, climate-resilient storage structures for harvested grains, and efficient agricultural waste management and post-harvest management operations such as proper harvesting, sun-drying, threshing, processing, packaging, and transportation [55].

Table 6. Climate-Smart agro-processing techniques by small, medium agro-processing enterprises

Techniques	True	False
Blanching	44(32.8)	45(13.4)
Solar milling equipment	37(27.6)	36(26.9)
Solar cold storage	30(29.0)	34(25.4)
Solar water pumps	36(26.0)	61(45.5)
Use of biogas	31(26.0)	46(34.3)
Use of biodigesters	39(26.0)	62(46.3)
Use of fast-cooking crop varieties	34(26.1)	63(47.0)
Use of fossil fuels	31(26.0)	44(32.8)
Use of fuelwood	32(26.0)	49(36.6)
Use of coal	31(26.0)	24(17.9)
Use of gas	29(26.0)	50(37.3)
Recycling of waste materials	34(26.0)	50(37.3)
Heating mechanisms used	31(26.0)	53(39.6)
Types of freezing techniques/chemicals used	41(26.1)	58(43.3)
Level of irradiation applied	40(26.1)	66(49.3)
High hydrostatic pressure processing	43(26.1)	66(49.3)
Level of homogenization	37(26.8)	73(54.5)
Level of pasteurization	39(26.9)	70(52.2)
Level of heat treatment of foods	39(26.9)	57(42.5)
Use of canning	31(26.3)	83(61.9)
Use of chemical pickling	31(26.3)	20(14.9)
Types of packaging materials used	37(26.8)	63(47.0)

Source: Field data, 2025.

Table 7 presents the results on constraints faced by agro-processors in the use of climate smart agro-processing techniques. The most prominent constraints are inadequate access to finance (72.4%) and unreliable electricity and high energy costs (63.4%). This may be due to the inability of agro-processing enterprises to access finance due to lack of collateral, business plans, credit history, high interest rates, short repayment periods, and complex loan procedures. Similarly, frequent blackouts, voltage fluctuations, and escalating diesel prices increase operational costs and reduce productivity, which narrow profit margins, energy challenges severely limit expansion and sustainability. The constraints to agro-processing as consisting of difficulties with supply chains for input and output market, prevalence of obsolete processing and ancillary equipment, low capacity and poor training, and lack of proper hygiene and sanitation practices [56]. Conversely, poor market information and linkages (17.2%) and limited skilled labour and technical expertise (21.6%) were the least constraints identified by agro-processors. This may be attributed to the lack of timely information and low technical know-how on climate-smart processing techniques. Agro-processors encounter constraints such as high financing rates, poor storage, few marketing routes, sluggish information access, and expensive equipment maintenance and emerging agro-processors also had to deal with marketing, high operational costs, and a lack of knowledge [32].

Table 7. Constraints faced in the use of climate smart agro processing techniques

Constraints	Yes	No	Very Severe	Severe	Not Severe
Inadequate access to knowledge and information on climate-smart agricultural technologies.	100(74.6)	34(25.3)	32(23.9)	60(44.8)	8(6.0)
Insufficient information on climate change initiatives.	99(73.9)	35(26.1)	30(22.4)	47(35.1)	22(16.4)
Lack of training on climate monitoring equipment.	93(69.4)	41(30.5)	35(26.1)	45(33.6)	13(9.7)
Poor working conditions in agro-processing facilities.	34(25.4)	100(99.7)	16(11.9)	17(12.7)	1(0.7)
Weak collaboration between extension services and meteorological agencies.	101(75.4)	33(31.2)	31(23.1)	56(41.8)	13(9.7)
Limited mobility and transportation for field staff.	79(59.0)	55(47.6)	30(22.4)	38(28.4)	11(8.2)
Absence of climate change subject matter specialists.	96(71.6)	38(34.9)	37(27.6)	47(35.1)	12(9.0)
Time constraints to attend training or awareness programs.	78(58.2)	56(41.7)	18(13.4)	41(30.6)	19(14.2)
High personal expenses in acquiring CSA-related skills.	94(70.1)	40(36.4)	39(29.1)	44(32.8)	9(6.7)

Contin. Table 7.					
Lack of available training resources on CSA practices.	96(71.6)	38(35.2)	37(27.6)	53(39.6)	6(4.5)
Poor organizational support for climate-smart training programs.	95(70.9)	39(35.7)	36(26.9)	50(37.3)	8(6.0)
CSA not integrated into agricultural training curricula.	97(72.4)	37(34.2)	44(32.8)	43(32.1)	9(6.7)
Absence of incentives for climate-smart agriculture training.	97(72.4)	37(34.4)	44(32.8)	42(31.30)	10(7.5)
Limited access to funding for green technology adoption.	97(72.4)	37(34.4)	38(28.4)	54(40.3)	5(3.7)
Lack of skilled personnel to operate CSA equipment.	98(73.1)	36(33.4)	40(29.9)	51(38.1)	6(4.5)

Source: Field data, 2025.

Binary logistic regression

The study employed binary logistic regression analysis to predict how various socio-economic and technological factors affected agro-processors' likelihood of attitude, and knowledge of climate-smart agro-processing techniques. The socio-economic and technological factors were considered as the predictor variables influencing an agro-processors' decision to use, get aware and attitudinal disposition towards climate-smart processing techniques. The dependent categorical variable coding was as follows; knowledge and attitude (high = 1, low = 0; favourable attitude = 1 and unfavourable attitude = 0). A Chi-square test was used to test the significance of the general regression model and to check if the group of factors significantly explained the knowledge and attitude towards climate-smart processing techniques.

The list and description of the predictor variables used in the binary logistic regression and their respective coding are as shown in Table 1.

The overall binary logistic regression results showed that the tested predictor variables (socio-economic and technological factors) significantly explained knowledge of climate-smart processing techniques ($p < 0.001$), and attitude towards climate-smart processing techniques ($p < 0.001$) by the agro-processors. Similar findings indicate that gender influences food processing activities [57], women have low participation in core agro-processing activities but only serve as labour [58], and inadequate financing limit adoption of value addition practices [31]. In the investigation of the model on the attitude towards climate smart processing techniques gave the values of Log likelihood (76.76), Cox & Snell R Square (0.648), Nagelkerke R Square (0.771), Chi Square (139.986), df (22), p (0.000) unfavourable (29) and favourable (105), which shows that the considered model fit the data at the significance level. The significant predictor variables for attitude towards climate smart agro-processing techniques are gender, age, education, business position, no employees, years of operation, types of economic activities, market orientation, access to financial support, info sources, energy type, types of products, by-product total,

and total no of agro-processing activities as stated in Table 8. The significance of these predictor variables aligns with other authors, gender influences food processing activities [57], women have low participation in core agro-processing activities but only serve as labour [58], inadequate financing limit adoption of value addition practices [31], limited number of products among agro-processing enterprises [59], and agro-processing activities influence agro-processors' attitude [60].

In the investigation of the model on the knowledge of climate smart processing techniques gave the values of Log likelihood (39.244), Cox & Snell R Square (0.614), Nagelkerke R Square (0.826), Chi Square (127.404), df (20), p (0.000) high knowledge (92) and low knowledge (42), which shows that the model fit the data at a suitable significance level. The significant predictor variables for knowledge of climate smart agro-processing techniques are total by-product management, APCST constraints, APCST Aware, and APCST Use. The significance of these predictor variables aligns with other authors, such as machinery, storage facilities, transportation and energy determine the use of agro-processing techniques [36, 60], preservatives, irradiation, radio waves and microwaves are not favored agro-processing techniques [61], level of education, years of experience, income influence agro-processing techniques [62].

Table 8: Determinants of attitude and energy use on climate smart processing techniques by SME agro-processors

Independent variables	Attitude towards climate smart processing				Knowledge of climate smart processing			
	B	Wald	Sig.	Exp(B)	B	Wald	Sig.	Exp (B)
Gender	2.841 (11450.367)	0.000	1.000	17.126	0.297 (1.117)	0.071	0.790	1.346
Age	-0.102 (1298.466)	0.000	1.000	0.903	0.029 (0.083)	0.124	0.725	1.030
Education	-3.792 (8379.932)	0.000	1.000	0.023	0.155 (0.470)	0.109	0.741	1.168
Business Position	4.292 (5770.714)	0.000	0.999	73.084	NA	NA	NA	NA
No employees	0.094 (102.150)	0.000	0.999	1.098	NA	NA	NA	NA
Years of Operation	-0.392 (2211.094)	0.000	1.000	0.676	0.333 (0.272)	1.494	0.222	1.395
Economic activities	11.280 (10272.279)	0.000	0.999	79233.788	1.561 (1.230)	1.610	0.204	4.762
Production activity	-5.433 (11509.532)	0.000	1.000	0.004	0.692 (1.159)	0.357	0.550	1.999
Social responsibility	0.552 (3844.063)	0.000	1.000	1.737	0.286 (1.268)	0.051	0.822	1.331
Market orientation	-4.661 (14859.824)	0.000	1.000	0.009	0.258 (0.361)	0.508	0.476	1.294
Access to financial support	-1.922 (5838.815)	0.000	1.000	0.146	-0.058 (0.183)	0.099	0.753	0.944
Info sources	-0.009 (2151.818)	0.000	1.000	0.991	14.766 (2614.438)	0.000	0.995	2587180.432
Energy type	-2.956 (5343.120)	0.000	1.000	0.052	-0.431 (0.290)	2.213	0.137	0.650
Types of products	2.068 (3589.784)	0.000	1.000	7.909	4.938 (4.357)	1.284	0.257	139.496
Products total	0.095 (22674.937)	0.000	1.000	1.100	0.990 (1.704)	0.337	0.562	2.690

Contin. Table 8. By-product total	-4.535 (13211.872)	0.000	1.000	0.011	-0.309 (0.314)	0.965	0.326	0.735
total by- product management	-1.324 (4158.721)	0.000	1.000	0.266	0.577 (0.341)	2.871	0.090	1.782
No of activities	2.249 (5319.550)	0.000	1.000	9.479	0.052 (0.313)	0.027	0.868	1.053
Total no of agro- processing activities	0.367 (6624.909)	0.000	1.000	1.444	NA	NA	NA	NA
APCST attitude	NA	NA	NA		0.002 (0.066)	0.001	0.970	1.002
APCST constraints	0.897 (569.385)	0.000	0.999	2.452	0.163 (0.088)	3.465	0.063	1.178
APCST Aware	NA	NA	NA	NA	-0.126 (0.072)	3.013	0.083	0.882
APCST Use	NA	NA	NA	NA	0.067 (0.031)	4.703	0.030	1.069
AWARE11	-6.412 (12811.105)	0.000	1.000	0.002	NA	NA	NA	NA
Use 11	11.279 (26275.792)	0.000	1.000	79149.585	NA	NA	NA	NA
Constant	-20.105 (32234.581)				-38.915 (2614.478)	0.000	0.988	0.000
-2 Log likelihood	76.76				39,244 ^a			
Cox & Snell R Square	0.648				0.614			
Nagelkerke R Square	0.771				0.862			
Chi Square	139.986				127.404			
df	22				20			
p	0.000				0.000			
Non observer	0 (29)				0 (42)			
Observer	1 (105)				1 (92)			

CONCLUSIONS

This paper provides empirical evidence on the attitude, knowledge and constraints associated with the climate smart agro-processing techniques in Sierra Leone using Binary logistic regression analysis. This is predicated on the fact that the quantum of research activities and publications on crops, water and soil activities and deserted the agro-processing aspects, notwithstanding, the quantity of greenhouse gas associated with such activities. Most of the agro-processors are mainly males, young, with no formal education, having low awareness, low knowledge, but favourable attitude, using radio, workshop & seminar are the most common source of information.

The most popular products are rice and rice-based products and cassava-based products, while prominent attitudinal statements are APCST require advanced technical knowledge, adopted when promoted by fellow processors, more effective when combined with digital tools for monitoring, essential for improving competitiveness in regional and international markets, and require support from government and NGOs for successful adoption. Agro-processors have low knowledge on use of canning, level of homogenization, level of pasteurization, high hydrostatic pressure processing, level of irradiation applied, use of fast-cooking crop varieties, types of packaging materials used, use of biodigesters. The most prominent constraints are inadequate access to finance and unreliable electricity and high energy costs. The significant predictor variables for attitude towards climate smart agro-processing techniques are gender, age, education, business position, no employees, years of operation, types of economic activities, market orientation, access to financial support, info sources, energy type, types of products, by-product total, and total no of agro-processing activities. However, the significant predictor variables for knowledge of climate smart agro-processing techniques are total by-product management, APCST constraints, APCST Aware, and APCST Use. These significant predictor variables indicate the important areas of interventions for the proper application of agro-processing techniques for climate adaptation and mitigation.

BIBLIOGRAPHY

1. Borchardt, M., Pereira, G., Milan, G., Pereira, E., Lima, L., Bianchi, R., & Scavarda do Carmo, A. 2025. Are Sustainable Supply Chains Managing Scope 3 Emissions? A Systematic Literature Review. *Sustainability*, 17(13), 6066. <https://doi.org/10.3390/su17136066>
2. Flammini, A., Adzmir, H., Pattison, R., Karl, K., Allouche, Y., & Tubiello, F. N. 2024. Greenhouse Gas Emissions from Cold Chains in Agrifood Systems. *Sustainability*, 16(21), 9184. <https://doi.org/10.3390/su16219184>
3. Ministry of Environment, Sierra Leone. 2024. *Annual Environmental Status Report*. Freetown: Government of Sierra Leone. Available at: https://epa.gov.sl/wp-content/uploads/2025/03/Annual-Report_EPA_final_compressed.pdf
4. Statistics Sierra Leone. 2021. Mid-Term Population and Housing Census Final Preliminary Report https://www.statistics.sl/images/StatisticsSL/Documents/Census/MTPHC_Preliminary_Report/Final_Preliminary_Report_2021_MTPHC.pdf
5. Hansen, A. D., Kuramochi, T., & Wicke, B. 2022. The status of corporate greenhouse gas emissions reporting in the food sector: An evaluation of food and beverage manufacturers. *Journal of cleaner production*, 361, 132279.
6. FAO. 2024. Greenhouse gas emissions from agrifood systems – Global, regional and country trends, 2000–2022. FAOSTAT Analytical Brief Series, No. 94. Rome. <https://openknowledge.fao.org/handle/20.500.14283/cd3167en>
7. GIZ. 2021. Energy Efficient Milling Machines: A Key to Sustainable Agro-Processing. Deutsche Gesellschaft für Internationale Zusammenarbeit. Retrieved from <https://www.giz.de/en/downloads/giz-energy-efficient-milling-machines.pdf>
8. UNDP. 2021. Climate-Smart Agriculture in Sierra Leone: Promoting Sustainable Agriculture through Local Interventions. United Nations Development Programme. https://www.sl.undp.org/content/sierra_leone/en/home/library/environment_climate/Promo_SustAgri.html
9. Mohammed, F., Zakaria, H., & Boateng, S. 2023. Factors that influence women agro-processors credit utilization in the northern region of Ghana. *Ghana Journal of Development Studies*, 20(1), pp.213-232.

10. Nawaz, A., Irshad, S., Luo, X., Walayat, N., Harlina, P.W., Qin, Z., Afzaal, M. and Islam, F., 2025. Advances in Green Food Processing Technologies: Enhancing Efficiency, Safety, and Sustainability. *Food Control*, p.111715.
11. World Bank.2023. Sierra Leone Economic Update: From Crisis to Recovery. <https://www.worldbank.org/en/news/feature/2023/01/23/sierra-leone-economic-update-from-crisis-to-recovery>
12. Fitawek, W., Karuaihe, S.T., Ntuli, H., Owusu-Sekyere, E., Sayed, N., & Schönfeldt, H.C. 2025. Exploring the role of small and medium food enterprises in enhancing food security among low-income consumers in South Africa. *VeriXiv*, 2(97), p.97.
13. Ministry of Agriculture & Food Security (MAFS). 2024. Feed Salone strategic pillars — aggregation, processing & market linkages. <https://maf.gov.sl/feed-salone-pillars/>. maf.gov.sl
14. Kouakou S-A (2024) Access to Financing Crucial for the Future of Agriculture in West Africa. <https://mastercardfdn.org/en/articles/access-to-financing-crucial-for-the-future-of-agricultureinwestafrica/#:~:text=The%20country%20has%20also%20encouraged,capacities%2C%20and%20create%20stable%20jobs>
15. UN Women. 2017. Sierra Leonean women in agribusiness are critical for inclusive economic growth.<https://africa.unwomen.org/en/news-and-events/stories/2017/06/women-in-agribusiness-in-sierra-leone#:~:text=Women%2C%20Cecil%20Nelson-,Mrs.,five%20children%20with%20no%20husband>
16. Ministry of Trade and Industry Sierra Leone. 2018. Sierra Leone Agro Processing Competitiveness Project Environmental and Social Management Framework. https://ewdata.rightsindevelopment.org/files/documents/95/WB-P160295_NIpDeWn.pdf
17. Mulugeta, T., Ilomo, M., Mueke, A., Onyango, C., Matsaunyane, L., Kritzing, Q., & Alexandersson, E. 2024. Smallholder farmers' knowledge, attitudes, and practices (KAP) regarding agricultural inputs with a focus on agricultural biologicals. *Heliyon*, 10(4).
18. Liao, X., Nguyen, T. P. L., & Sasaki, N. 2022). Use of the knowledge, attitude, and practice (KAP) model to examine sustainable agriculture in Thailand. *Regional Sustainability*, 3 (1), pp.41-52.
19. Sarr, M., Majili, Z., Khalili, N., Matavel, C. E., Mbwana, H. A., Kaingo, J., Löhr, K. & Rybak, C. 2024. Adoption of processing technologies and innovative food preservation techniques: findings from smallholders in the Lindi Region in Tanzania. *Frontiers in Sustainable Food Systems*, 7, p.1169578.
20. Meijer, S. S., Catacutan, D., Ajayi, O. C., Sileshi, G. W., & Nieuwenhuis, M. (2015). The role of knowledge, attitudes and perceptions in the uptake of agricultural and agroforestry innovations among smallholder farmers in sub-Saharan Africa. *Int. Journal of Agricultural sustainability*, 13(1), pp.40-54.
21. Chuang, J. H., Wang, J. H., & Liou, Y. C. 2020. Farmers' knowledge, attitude, and adoption of smart agriculture technology in Taiwan. *International Journal of Environmental Research and Public Health*, 17(19), p.7236.
22. Intergovernmental Panel on Climate Change (IPCC), ed. Climate Change 2022 - Mitigation of Climate Change: Working Group III Contribution to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press; 2023. <https://doi.org/10.1017/9781009157926>
23. Galadima, M., Hassan, S., Man, N., & Abu, I. A. 2019. Role of knowledge, attitude, on the adoption of improved pearl millet by farmers in North-east, Nigeria. *International Journal of Recent Technology and Engineering*, 8(4), pp.9100-9105.
24. Mbesa, B., Makindara, J., Kadigi, M., Majubwa, R., & Madege, R. 2024). Effect of training on knowledge, attitude, and practice on the use of hermetic storage technologies among smallholder farmers in Tanzania. *African Journal of Empirical Research*, 5(2), pp.881-893.
25. Malinza, A.O., & Mahonge, C. 2024. Farmers' Knowledge, Attitude, and Practices Towards Fertiliser Indicator Pricing Approach in Mvomero District, Tanzania. *South African Journal of Agricultural Extension*, 52(5), pp.115-136. <https://doi.org/2413-3221/2024/v52n5a16388>

26. Patil, V., & Veettil, P. C. 2024. Farmers' risk attitude, agricultural technology adoption and impacts in Eastern India. *Agriculture & Food Security*, 13 (1), p.50.
27. Namagembe, S., & Mbago, M. 2023. Small and medium enterprise agro-processing firms supply chain performance: The role of owner-manager's managerial competencies, information sharing and information quality. *Modern Supply Chain Research and Applications*, 5(4), pp.265-288.
28. Barman, B., Singh, R., Padaria, R. N., Nain, M. S., & Quader, S. W. Modeling Determinants of Farmers' Attitudes and Adoption Willingness Toward Agricultural Drones: A PLS-SEM Study in India. *Frontiers in Sustainable Food Systems*, 9, 1695231.
29. Abdullahi, K. A., Oladele, O.I., & Akinyemi, M. 2021. Attitude, knowledge and constraints associated with the use of mobile phone applications by farmers in North West Nigeria. *Journal of Agriculture and Food Research*, vol.6, p.100212.
30. Ladapo, M. A., & Oladele, O. I. 2011. Effect of Knowledge, Attitude and Constraints on Postharvest losses among plantain farmers and wholesalers in south-western Nigeria. *Life Science Journal-Acta Zhengzhou University Overseas Edition*, 8(2), pp.476-482.
31. Mwale, T., & Mwange, A. 2025. Assessing the Constraints of Value Addition to Agricultural Products of Small and Medium Scale Farmers in Chongwe District, Zambia. *African Journal of Commercial Studies*, 6(2), 127-147. <https://doi.org/10.59413/ajocs/v6.i2.12>
32. Balakrishnan, R., Mann, S., Kumar, A., Murai, A. S., Sharma, R., Mittal, S., & Singh, M. 2024. Perceived constraints in agro-processing in unorganized agri-businesses: Learning from Trans-Gangetic Plains. *The Indian Journal of Agricultural Sciences*, 94(3-1), pp.18-25.
33. Sierra Leone Chamber for Agribusiness Development (SLCAD) (SLCAD, 2022. Access to Inputs for Agricultural Exports in Sierra Leone Improving policies and regulatory frameworks for access to seeds, fertilizers and essential machinery. <https://www.intracen.org/file/policy-paper-access-to-agri-inputs-in-slpdf>
34. Rusliyadi, M., Ardil, Y. W. Y., & Winarno, K. 2023. Binary Logistics Regression Model to Analyze Factors Influencing Technology Adoption. In *Proceedings of the International Symposium Southeast Asia Vegetable 2021 (SEAVEG 2021)* (Vol. 23, p. 460). Springer Nature.
35. Akpan, S. B., Offor, O. S., & Archibong, O. E. 2020. Access and demand for credit among small-scale agro-based processors in Uyo agricultural zone, Akwa Ibom State, Nigeria. *Nigeria Agricultural Journal*, 51(1), 132–141. <http://www.ajol.info/index.php/naj>
36. Mthombeni, D. L., Antwi, M. A., & Oduniyi, O. S. 2022. Factors influencing access to agro-processing training for small-scale crop farmers in Gauteng province of South Africa. *Agriculture & Food Security*, vol. 11(1), p.31.
37. Manasoe, B., Mmbengwa, V.M., & Lekunze, J.N.2024. The Influence of Capacity Building on Small-Scale Agro-Processors in South Africa: Lessons for Agricultural Extension Advisory Services. *South African Journal of Agricultural Extension*, vol.52(3), pp.55-84. <https://doi.org/10.17159/2413-3221/2024/v52n3a15543>
38. AUC/OECD 2024. Africa's Development Dynamics 2024: Skills, Jobs and Productivity, OECD Publishing, Paris, <https://doi.org/10.1787/df06c7a4-en>.
39. Mhlongo, T., & Daya, P. 2023. Challenges faced by small, medium and micro enterprises in Gauteng: A case for entrepreneurial leadership as an essential tool for success. *The Southern African Journal of Entrepreneurship and Small Business Management*, 15(1), 12 pages. doi:<https://doi.org/10.4102/sajesbm.v15i1.591>
40. Thoto, F.S., Chogou, S.K., Honfoga, B.G., & Houessou, M.D. 2021. Characteristics of agricultural entrepreneurs and their agribusinesses in sub-Saharan Africa: Evidence from Benin. *African J. of Food, Agriculture, Nutrition and Development*, 21(8), pp.18593-18610.
41. Faeth, P and Banda T. 2023. Productive Uses of Energy in African Agriculture Could Reduce Poverty. <https://www.abtglobal.com/files/insights/white-papers/2023/energyinag-whitepaper-v4.pdf>

42. Cai, K., Lemaire, T., Medici, A., Melina, G., Schwerhoff, G., & Thube, S. D. 2024. Harnessing Renewables in Sub-Saharan Africa – Barriers, Reforms, and Economic Prospects. *Staff Climate Notes*, 2024(005), A001. Retrieved Nov 29, 2025, from <https://doi.org/10.5089/9798400290107.066.A001>
43. Bangura, A. B. M., Hantoro, R., Fudholi, A., & Uwitije, P. D. 2022. Parametric study of a solar dryer system for the development and application of solar energy in Sierra Leone. *Journal of Applied Engineering Science*, 20(2), pp.408-419
44. Adu-Baffour, F., Daum, T., & Birner, R. 2019. Can small farms benefit from big companies' initiatives to promote mechanization in Africa? A case study from Zambia. *Food policy*, 84, pp.133-145.
45. Okuthe, G. 2024. Valorizing Fruit and Vegetable Waste: The Untapped Potential for Entrepreneurship in Sub-Saharan Africa—A Systematic Review. *Recycling*, 9(3), 40. <https://doi.org/10.3390/recycling9030040>
46. Boakye, K., Akaba, S., Awuye, S., Danso, H., & Mensah, S. 2025. Sustainability in Agricultural Value Chains: Evidence from the Pineapple Sector in Ghana. *Research on World Agricultural Economy*, pp.681-699.
47. Ameh, S. D., Adi, K. F., Ibrahim, S. Y., Suleiman, N. O., Onah, R. O., & IC, O. 2025. Analysis of women adoption and utilization of selected NCAM agro-processing equipment. *Journal of Agricultural Mechanization (AGRIMECH)*, Volume V, June, 2025 80 <https://doi.org/10.63749/agrimech.5.1.1008x>
48. UNIDO 2024. Impact Stories: Developing West Africa Competitiveness (WACOMP) <https://www.unido.org/sites/default/files/unido-publications/2024-09/Fact%20Sheet%20-%20Developing%20West%20Africa%20Competitiveness%20%28WACOMP%29-v7-Digital.pdf>
49. Reardon, T., Tschirley, D., Liverpool-Tasie, L. S.O., Awokuse, T., Fanzo, J., Minten, B., Vos, R., Dolislager, M., Sauer, C., Dhar, R., Vargas, C., & Popkin, B. M. 2021. The processed food revolution in African food systems and the double burden of malnutrition. *Global food security*, 28, 100466.
50. Khowa, T., & Mukasi, T. 2021. Agro-processing as a tool for poverty alleviation strategy: A case of Raymond Mhlaba municipality. *Africa's Public Service Delivery & Performance Review*, 9(1), 7 pages. doi:<https://doi.org/10.4102/apsdpr.v9i1.463>
51. Joshua, J.M., Massawe, F.A., & Mwakalapuka, A.A. 2020. The relationship between farmers' attitude towards the improved cassava processing technology and adoption. *International Journal of Agricultural Extension and Rural Development Studies* Vol.8, No.3, pp.25-38 2021
52. Onyemma, J.O., Tokula, M., Tertsea, K. M., & Chimela, N.S. 2019. Impact of improved cassava technology adoption on farmers output in Benue state, Nigeria. *Journal of Agricultural and Life Sciences (JALSI)*, 21, pp.1-10.
53. Haslbeck, J., Martinez, A.J., Roefs, A.J., Fried, E.I., Lemmens, L.H., Groot, E., & Edelsbrunner, P.A. 2025. Comparing likert and visual analogue scales in ecological momentary assessment. *Behavior Research Methods*, 57(8), pp.1-41.
54. AGRIFOCUS 2025. The Impact of Climate Change on Agro-Processing. <https://theagrifocus.com/the-impact-of-climate-change-on-agro-processing/#:~:text=The%20Caribbean%20agro%2Dprocessing%20sector,investment%20in%20renewable%20energy%20solutions>
55. Osuji, E. E., Anosike, F. C., Obasi, I. O., Nwachukwu, E. U., Obi, J. N., Orji, J. E., Inyang, P., Chinaka, I.C., Osang, E.A., Iroegbu, C.S. and Nzeakor, F.C., & Onu, S. E. 2023. Integration of Climate Smart Agro-Technologies and Efficient Post-Harvest Operations in Changing Weather Conditions in Nigeria. *Journal of Agriculture and Crops*, 9(3), pp.281-292.
56. Lambert, I. 2001. Problems and constraints to the development of the agro-processing sector. In *Dominica Country Conference*, Cave Hill Campus, University of the West Indies, Barbados, January. Product Development, Cost Seasonality, Region Marginalization/17. <https://global.uwi.edu/sites/default/files/bnccde/dominica/conference/papers/Lambert.html>

57. Ramirez-Santos, A. G., Ravera, F., Rivera-Ferre, M. G., & Calvet-Nogués, M. 2023. Gendered traditional agroecological knowledge in agri-food systems: A systematic review. *Journal of Ethnobiology and Ethnomedicine*, vol.19(1), p.11.
58. Musa, M. O., Adesiji, G. B., Adebayo, S. A., & Komolafe, S. E. 2024. Gender analysis by participation in agro processing groups in North-Central, Nigeria. *Bulletin of the Institute of Tropical Agriculture, Kyushu University*, 47, pp.113-121.
59. Owoo, Nkechi S.; Lambon-Quayefio, Monica P. 2017. The agro-processing industry and its potential for structural transformation of the Ghanaian economy, WIDER Working Paper, No. 2017/9, ISBN 978-92-9256-233-5, The United Nations University World Institute for Development Economics Research (UNU-WIDER), Helsinki, <https://doi.org/10.35188/UNU-WIDER/2017/233-5>
60. Khoza, T. M., Senyolo, G. M., Mmbengwa, V. M., & Soundy, P. 2019. Socio-economic factors influencing smallholder farmers' decision to participate in agro-processing industry in Gauteng province, South Africa. *Cogent Social Sciences*, 5(1), p.1664193.
61. Guzik, P., Szymkowiak, A., Kulawik, P., & Zajac, M. 2022. Consumer attitudes towards food preservation methods. *Foods*, 11(9), p.1349.
62. Adeniyi, V.A., Akangbe, J. A., & Kolawole, A. E. 2023. Women cassava processors' livelihood; implications for improved processing technology usage in Nigeria. *Cogent Soc Sci*. 2023.

STAV, ZNANJE I OGRANIČENJA POVEZANA SA TEHNIKAMA KLIMATSKI PAMETNE AGRO-PRERADE U DRŽAVI SIERA LEONE

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Apstrakt: Cilj ovog istraživanja je ispitivanje stavova, nivoa znanja i ograničenja povezanih sa primenom klimatski pametnih tehnika agroprerade (eng. smart agro-processing), za državu Sijera Leone, uz upotrebu binarne logističke regresione analize. Istraživački uzorak obuhvatio je 150 prerađivača poljoprivrednih proizvoda, od kojih je tehnikom jednostavnog slučajnog uzorka odabrano 134 ispitanika. Podaci su prikupljeni primenom strukturisanog upitnika koji je prethodno validiran u pogledu sadržaja i pokazuje koeficijent pouzdanosti od 0,80.

Statistička obrada podataka obavljena je korišćenjem softverskog paketa SPSS (verzija 26), primenom frekvencijskih distribucija, procentualne analize i binarne logističke regresije.

Rezultati su pokazali da većinu prerađivača čine muškarci mlađe starosne dobi, uglavnom bez formalnog obrazovanja, sa 5 do 10 godina poslovnog iskustva, niskim nivoom svesti i znanja, ali pozitivnim stavovima prema klimatski pametnim praksama.

Kao najzastupljeniji izvori informacija identifikovani su radio emisije, stručne radionice i seminari. Najčešće prerađivani poljoprivredni proizvodi su pirinač i proizvodi na bazi pirinča (41,8%), kao i proizvodi od kasave (Cassava) (33,6%).

Analiza je pokazala da su značajne prediktorske (ulazne, nezavisne) varijable za stav prema klimatski pametnim tehnikama agroprerade: pol, starost, nivo obrazovanja, poslovna pozicija, broj zaposlenih, godine poslovanja, tip ekonomskih aktivnosti, tržišna orijentacija, pristup finansijskoj podršci, izvori informacija, tip energije, vrste proizvoda, ukupan broj nusproizvoda i ukupan broj agroprerađivačkih aktivnosti.

Sa druge strane, značajne (zavisne) prediktorske varijable za nivo znanja o ovim tehnikama obuhvataju: upravljanje ukupnim nusproizvodima, ograničenja klimatski pametnih tehnika (eng. APCST Constraints), nivo informisanosti (eng. APCST Aware) i stepen njihove primene (eng. APCST Use).

Dobijeni rezultati ukazuju na ključne oblasti intervencija koje su neophodne za efikasnu implementaciju klimatski pametnih tehnika agroprerade, radi poboljšanja adaptacije i ublažavanja posledica klimatskih promena u agro-prerađivačkom sektoru države Sjera Leone.

Ključne reči: Klimatski pametna agro-prerada, svest, ograničenja, stav

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